“Conformational motion of enzymes …” - DMR 0105903
and “Study of DNA-binding proteins …” - DMR 0405632

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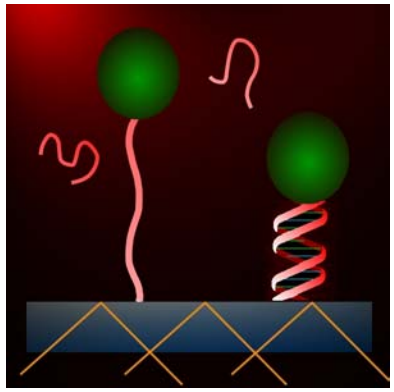
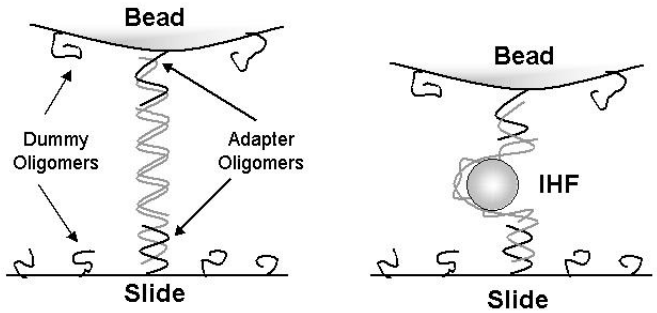


This nanodevice uses a single molecule sensor to detect a specific sequence in a mixture of DNA molecules.

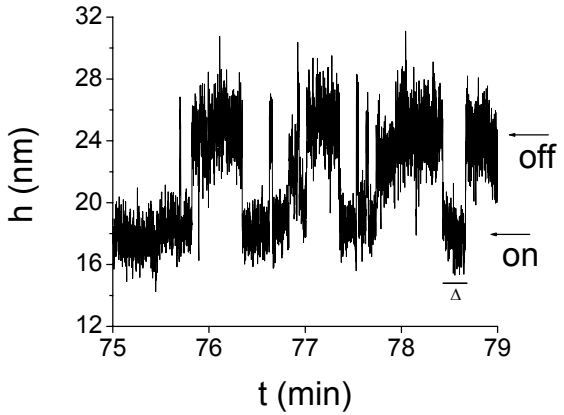
[PNAS **100**, 7605 (2003)]

It can monitor in real time a single protein (IHF) binding and falling off a short piece of DNA.



We use this device to study the dynamics of fundamental processes such as DNA looping. This nanotechnology may form a platform for high-sensitivity molecular diagnostic assays.

The graph is a direct measurement of the “molecular dance” sketched in the cartoon above: when the protein binds (“on”), the DNA bends and shortens from 26 to 18 nm; when the protein unbinds (“off”), the DNA stretches out again.



The molecules of life – proteins, DNA – interact within the living cell in a spectacular molecular dance, where partners must find each other and direct each other's steps. Traditional methods of analysis such as X-ray crystallography examine these processes through snapshots frozen in time. We have developed a new method to directly observe certain steps of the molecular dance as they happen in real time. Specifically, we employ a nanodevice to observe the process of a single protein molecule interacting with a short stretch of DNA.

From a basic science perspective, this device allows the study, on a single-molecule basis, the dynamics of fundamental processes such as DNA looping, which is involved in the regulation of eukaryotic genes. Such advances will contribute to shape our way of thinking about the molecules of life, and will eventually translate into the ability to engineer new devices at the molecular scale.

- The experimental biophysics program in the Physics Department at UCLA was established through this NSF support.
- Research in the PI's lab is synergistic with the newly established Biophysics Major in the undergraduate curriculum within the Department.
- This research cuts across disciplines, broadening the scientific outlook of the graduate students and postdoctoral researchers involved, who get trained in the current frontiers of molecular biophysics and nano-technology.
- Two graduate students (Jeungphill Hanne and Vassili Ivanov) and one Postdoc (Sanhita Dixit, now at UC Davis) have contributed to the experiments.

- The research above has been featured on the UCLA and CNSI websites, in magazines (New Scientist, Biophotonics), nanotechnology news journals (Silicon Valley Business Journal, Science Today, TechNewsWorld, etc.) and by United Press International (UPI).